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WEST VIRGINIA UNIVERSITY
AGRICULTURAL EXPERIMENT STATION,
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EXPERIMENTS WITH

Buckwheat and Oats.

By J. H. STEWART and HORACE ATWOOD.

[The Bulletins and Reports of this Station will be mailed free to any citizen of West Virginia upon written application. Address, Director of Agricultural Experiment Station. Morgantown, W. Va.]

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Experiments with Buckwheat.

According to the statistics of the United States Department of Agriculture there are only five states in the Union—Maine, New York, Pennsylvania, Michigan and Wisconsin—which produce more buckwheat than West Virginia, while from twenty to twenty-five states produce more corn, wheat, rye, hay and potatoes. This fact indicates that there must be many sections of this State in which the climate and soil are naturally well adapted to the production of buckwheat, and as the demand for buckwheat flour is increasing both at home and abroad, more attention should be paid to the culture of this crop, especially in the elevated portions of the State where the summers are not too hot. Buckwheat is easily injured by hot, dry weather.

During the past five years the station has studied the influence of different fertilizers upon the yield of grain, and compared a few of the standard varieties. The experiments have been conducted at the station farm at Morgantown, and at the testing grounds in the glade district near Reedsville, in Preston county. The following tables give the main details of the fertilizer experiments.

The experiments conducted in Preston county have been under the direct supervision of Mr. John Guseman, to whom acknowledgement is due for the care exercised in laying out the plats, applying the fertilizers, sowing the seed and harvesting the crops.

The following tables show the yield of buckwheat upon the experiment plats in Preston county, from 1898 to 1902 inclusive. The Japanese variety was used each year:

RESULTS FOR 1898.

Sowed June 24th, harvested Sept. 7th.

APPLICATION PER ACRE.	YIELD PER ACRE.
200 lbs. sodium nitrate.....	17.5 bushels
400 lbs. potassium sulphate.....	21.2 bushels
400 lbs. acid phosphate.....	43.7 bushels
No fertilizer,	17.5 bushels

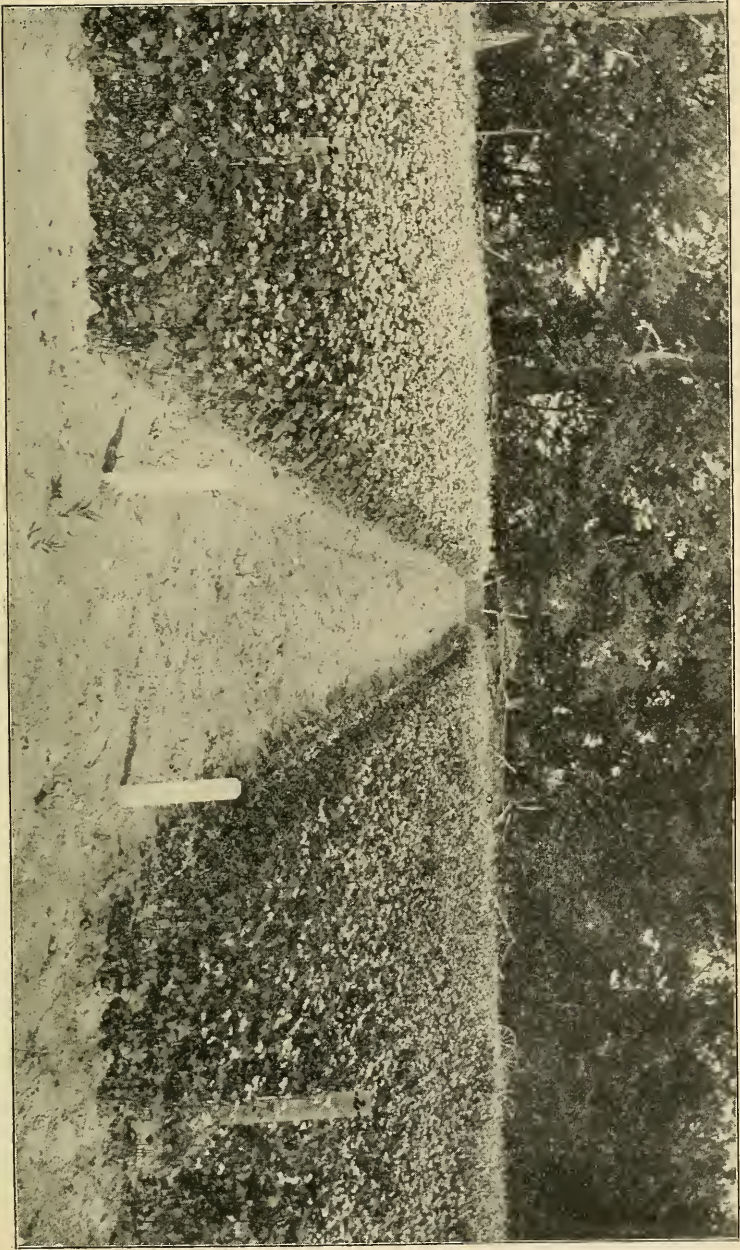
In 1898 the application of sodium nitrate was apparently of no benefit. The potassium sulphate increased the yield but slightly, while the acid phosphate more than doubled the yield compared with the plat to which no fertilizer was applied.

RESULTS FOR 1899.

Sowed July 10th, harvested Sept. 15th.

APPLICATION PER ACRE.	YIELD PER ACRE.
188 lbs. sodium nitrate.....	10.0 bushels
90 lbs. potassium sulphate.....	17.7 bushels
77 lbs. acid phosphate.....	31.6 bushels
No fertilizer.....	Result lost

The acid phosphate plat yielded nearly twice as much as the potassium sulphate plat, and more than three times as much as the sodium nitrate plat.



Phosphoric Acid,

Nitrogen

RESULTS FOR 1900.

Sowed June 25th, harvested Sept. 3rd.

APPLICATION PER ACRE.	YIELD PER ACRE.
400 lbs. sodium nitrate.....	23.8 bushels
400 lbs. potassium sulphate.....	23.1 bushels
400 lbs. acid phosphate.....	40.0 bushels
200 lbs. sodium nitrate.... }	23.1 bushels
200 lbs. potassium sulphate. }	
200 lbs. sodium nitrate. }	28.3 bushels
200 lbs. acid phosphate.... }	
200 lbs. potassium sulphate. }	28.1 bushels
200 lbs. acid phosphate.... }	
133 lbs. sodium nitrate. }	25.4 bushels
133 lbs. potassium sulphate. }	
133 lbs. acid phosphate. }	
No fertilizer	22.0 bushels

Neither the sodium nitrate nor the potassium sulphate materially increased the yield of grain, when used alone or in combination with each other. The acid phosphate, however, exerted a beneficial influence upon the yields of all the plats to which it was applied, the largest yield being obtained from the plat on which only acid phosphate was used.

RESULTS FOR 1901.

Sowed July 3rd, harvested Sept. 10th.

APPLICATION PER ACRE.	YIELD PER ACRE.
150 lbs. acid phosphate.....	33.7 bushels
200 lbs. acid phosphate.....	35.4 bushels
300 lbs. acid phosphate.....	39.6 bushels
400 lbs. acid phosphate.....	39.8 bushels
200 lbs. acid phosphate,	38.7 bushels
200 lbs. sodium nitrate.... }	
200 lbs. acid phosphate,..... }	39.4 bushels
200 lbs. Potassium Sulphate, }	
200 lbs. acid phosphate. }	40.2 bushels
200 lbs. sodium nitrate. }	
100 lbs. potassium sulphate }	
No fertilizer	22.7 bushels
No fertilizer but lime in 1899.....	32.1 bushels

Regarding the application of different amounts of acid phosphate the table shows that amounts in excess of 150 lbs. per acre increased the yield but slightly. The most striking result of this test was the beneficial effect of the lime which was applied in 1899 at the rate of 30 bushels of stone lime per acre.

RESULTS FOR 1902.

Sowed July 8th, harvested Sept. 18th.

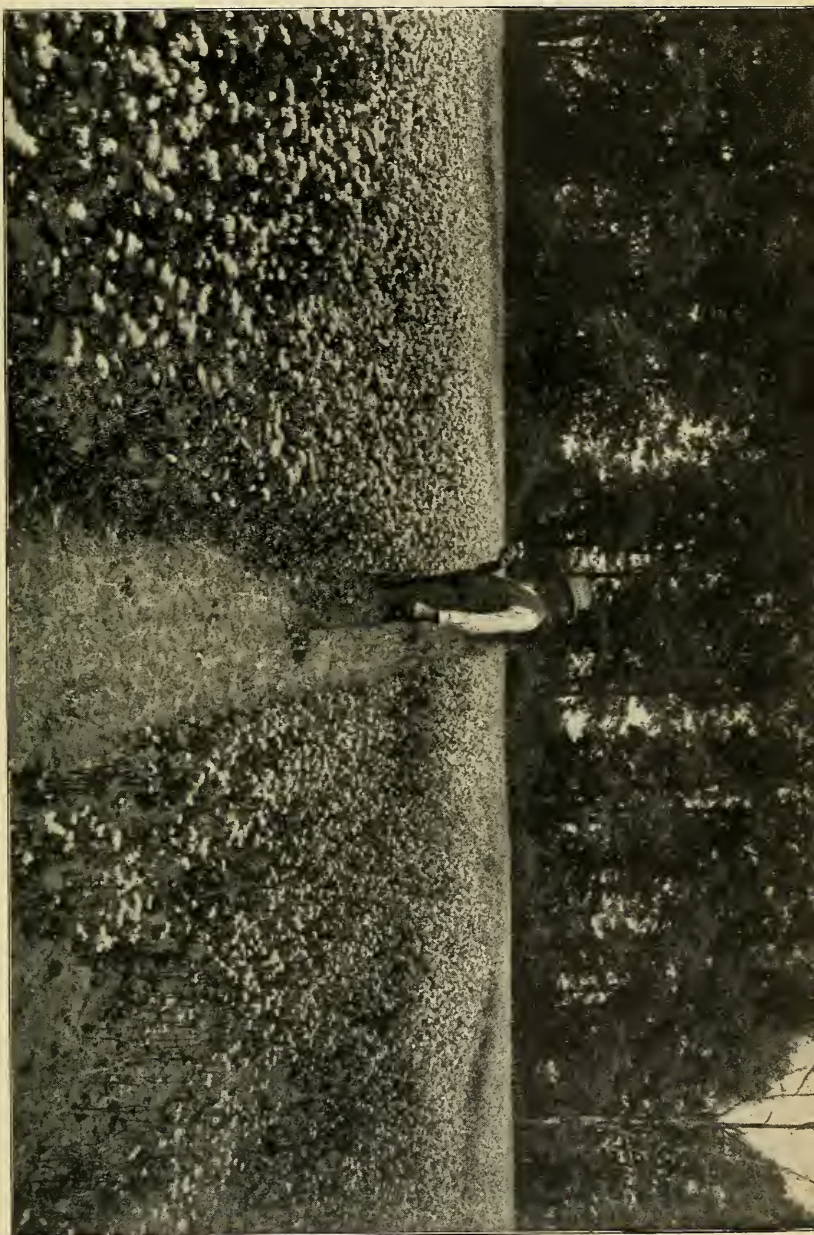
APPLICATION PER ACRE.		YIELD PER ACRE.
90 lbs. sodium nitrate.....		23.4 bushels
200 lbs. acid phosphate.....		31.4 bushels
70 lbs. potassium sulphate.....		26.6 bushels
No fertilizer		24.7 bushels
90 lbs. sodium nitrate.	}	46.8 bushels
200 lbs. acid phosphate.....		
90 lbs. sodium nitrate.	}	34.6 bushels
70 lbs. potassium sulphate..		
200 lbs. acid phosphate.	}	42.9 bushels
70 lbs. potassium sulphate..		
90 lbs. sodium nitrate.	}	35.1 bushels
200 lbs. acid phosphate.		
70 lbs. potassium sulphate..		

During this test wet weather somewhat injured the buckwheat upon the first two plats, as a portion of each of these plats was upon land slightly lower than the remainder of the field. The table, however, gives the actual yields.

In this experiment neither sodium nitrate nor potassium sulphate was of much benefit when used alone, but when used in connection with each other a better result was obtained. The acid phosphate, as in former years, increased the yield of all of the plats to which it was applied.

GENERAL SUMMARY.

The tests for five years show that a fertilizer for buckwheat raised on the glade lands of Preston county should be very rich in phosphoric acid, and possibly should contain a small amount of nitrogen and potash.



Phosphoric Acid.

Potash.

The following table shows the details of the fertilizer tests with buckwheat at the station farm:

RESULTS FOR 1898.

Sowed July 6th, harvested Sept. 13th.

APPLICATION PER ACRE.	YIELD PER ACRE.
Sodium nitrate, 200 lbs.....	23.8 bushels
Potassium chloride, 200 lbs.....	27.0 bushels
Thomas slag, 200 lbs.....	28.6 bushels
Acid Phosphate, 200 lbs.....	30.6 bushels

RESULTS FOR 1899.

Sowed July 12th, harvested Sept. 12th.

APPLICATION PER ACRE.	YIELD PER ACRE.
Sodium nitrate, 300 lbs.....	10.4 bushels
Potassium sulphate, 400 lbs.....	9.0 bushels
Acid phosphate, 400 lbs.....	13.2 bushels
No fertilizer	9.8 bushels

In 1898 the buckwheat on the plats receiving phosphoric acid grew very luxuriantly, and in all probability the yield would have been at the rate of 40 bushels or more per acre, but a severe wind and rain storm shortly after the buckwheat had begun to bloom, injured the phosphoric acid plats very severely without doing much damage to the other plats with a much shorter growth of straw, so, under normal conditions, the difference in yield would have been much greater than is shown in the table. The photograph, taken three weeks after drilling, shows the striking effect of an abundance of phosphoric acid upon the early development of the buckwheat plant.

In 1899 the dry weather, which began shortly after the buckwheat was sown, and continued almost until the buckwheat was harvested, very materially diminished the yield of all of the plats.

Although the experiments at the station farm do not show

that phosphoric acid had such a striking influence upon the yield as was the case in Preston county, yet the beneficial effect is noticeable, and it may be safely concluded that a fertilizer for buckwheat should be very rich in phosphoric acid.

VARIETIES.

Japanese, Silverhull, Gray and Russian were grown at the Station Farm in 1899, but on account of the very dry weather no conclusion could be drawn from the test of that year, as none of the varieties yielded a good crop. The following table gives the results obtained at the Station Farm and in Preston county in 1900 and 1901.

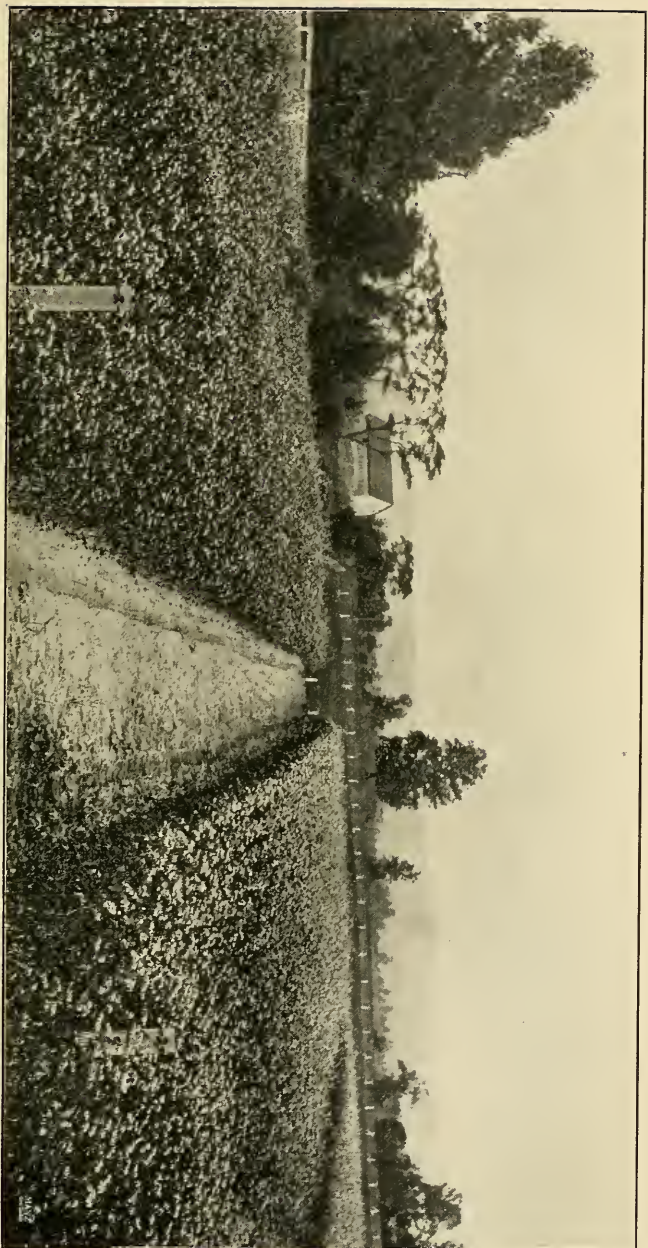
Table showing the yield of different varieties of buckwheat. Fertilized at the rate of 300 pounds of acid phosphate per acre:

Variety.	Yield per acre.			Average
	Station Farm.	Preston County.		
	1900	1900	1901	
	23.7			
Japanese	26.7	39.3	35.4	31.3
Silverhull	23.3	15.4	20.1	19.6
Gray	22.1	14.1	18.2	18.1
Russian	19.5	20.6	22.5	20.8

The Japanese variety gave an average yield of more than ten bushels per acre more than any of the other varieties.

NORTHERN AND SOUTHERN GROWN SEED.

In the spring of 1900 some Japanese buckwheat was obtained which had been grown for several years in Ontario, Canada. It was sown beside the same variety which had been raised in West Virginia. The plat seeded to northern grown seed yielded at the rate of 26.7 bushels per acre, and the plat sown to West Virginia seed at the rate of 23.7 bushels, giving a balance in favor of the northern grown seed of exactly three bushels per acre. If future trials show as great an average difference as in this instance, it will pay farmers to obtain seed buckwheat from the North.



Nitrogen and Potash.

Phosphoric Acid and Nitrogen.

DIFFERENT DATES OF SOWING BUCKWHEAT.

In a considerable portion of this State two crops of buckwheat can be raised annually, the first crop ripening in July, and the second late in September or early in October. When two crops are raised annually there can be little choice as to the dates of sowing, for then it is necessary to make the first sowing as early as practicable in the spring, and the second as soon as the preceding crop is removed. Buckwheat can be sown without danger from frost quite early, for while the plants are still small, with only two leaves, they can endure a fairly severe frost without injury.

In 1900, two crops of buckwheat were successfully grown upon the Station Farm. For the first crop the seed was sown May 5th, and the crop was harvested July 26th; for the second crop the seed was sown August 11th, and the crop harvested October 1st. Owing to the severe drought which prevailed during August and September, the second crop was light, but in a year with average rainfall during this period there is no reason why there should not have been a very good second crop.

Several plats were sown to buckwheat at different times in the summer of 1900. The field selected for this test was extremely poor and none of the yields were satisfactory. The following table gives the details of the test:

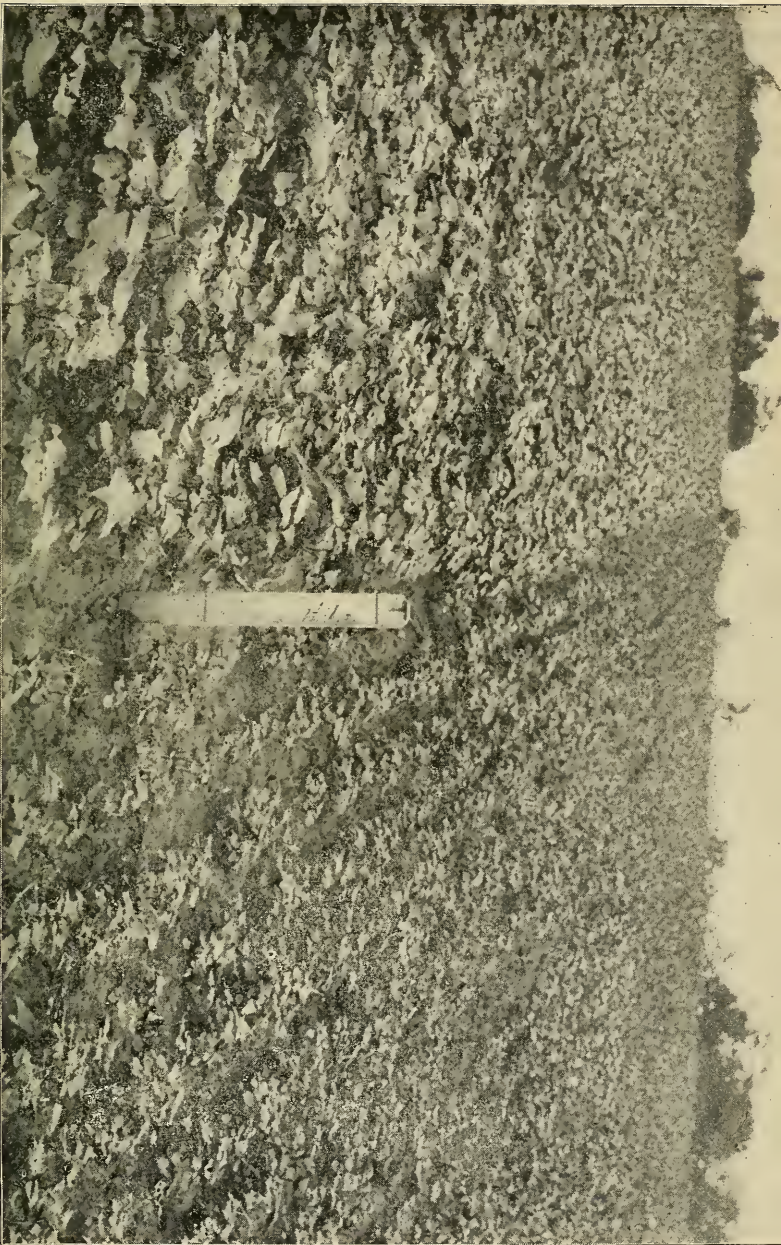
BUCKWHEAT SOWN AT DIFFERENT DATES.

When sown.	When harvested.	Yield per acre.
May 5.	July 26	20.8
" 12.	" 26	20.8
" 22.	Aug. 10	22.5
" 28	" 17	26.2
June 6.	" 20	25.8
" 21.	" 29	20.0
July 2.	Lodged badly by	
" 13.	heavy storm and	
	not harvested.	

The sowing made May 28th, gave the largest yield.

SUGGESTIONS CONCERNING THE RAISING OF BUCKWHEAT.

Plow buckwheat land as early as possible in the spring, and harrow occasionally until the seed is sown. This early plowing and harrowing aids in changing into a soluble and hence available form, some of the insoluble nitrogenous compounds of the soil. This will usually supply sufficient nitrogen. The early plowing also allows the soil to become sufficiently compact immediately below the surface, which is an aid in preventing injury from dry weather. Sow one bushel of seed, and apply from 150 to 300 lbs. of acid phosphate per acre.



Phosphoric Acid.

No Fertilizer.

A Variety Test of Oats.

Oats thrive best in a cool, moist climate, and in those sections of the country where the climatic conditions are not especially favorable for the perfect development of this crop it is of much importance to select those varieties which are best able to withstand the adverse conditions.

During the past three years a number of varieties have been tested and the yields of grain and straw are shown in the following tables:

RESULTS FOR 1900.

The land upon which the oats were grown produced a crop of sugar beets in 1899. The plowing was done early in the spring, and the oats were drilled on the 10th of April. The plats were each one-twentieth of an acre in size and were uniformly fertilized at the rate of 600 lbs. of complete fertilizer per acre. As the latter part of the season was favorable, a fair growth of straw resulted in the case of most of the varieties. All of the varieties were more or less affected with rust and smut, the smut doing the principal damage. The Extra Ripe variety, Black Spring, Black Prolific and Golden Giant were smutted badly.

The following table gives the names of the different varieties, the date of harvest and the yield of grain and straw per acre:

Variety.	Seedsman.	Harvested.	Straw.	Grain.
Extra Sweedish	Livingston.	July 16	2280 lbs	67.8 bu
Black Prolific	Salzer....	" 13	2180 "	67.2 bu
Silver Mine	Salzer.....	" 12	2400 "	65.0 bu
White Bonanza	Salzer....	" 16	2160 "	63.1 bu
Amer. Banner	Livingston	" 12	2240 "	62.8 bu
Big Four White	Salzer...	" 12	2140 "	60.9 bu
Imp. American	Livingston	" 16	2240 "	60.3 bu
White Russian	Salzer.....	" 14	2340 "	60.0 bu
Great Northern	Salzer....	" 14	1780 "	57.8 bu
Welcome	Salzer....	" 12	1980 "	57.8 bu
Bow of Promise	Salzer..	" 14	1680 "	53.7 bu
Danish Island	Burpee	" 13	2300 "	53.4 bu
White Spring	Wood.	" 12	2100 "	52.2 bu
White Sup. Scotch	Salzer.	" 11	1800 "	50.3 bu
Welcome	Burpee.	" 11	1880 "	49.7 bu
Red Rust Proof	Wood.	" 13	1460 "	49.3 bu
Black Spring	Wood..	" 9	1600 "	46.5 bu
Probster	Henderson.	" 20	1980 "	46.2 bu
Clydesdale	Henderson..	" 16	1460 "	40.9 bu
Black Tartarian	Henderson	" 11	1620 "	39.0 bu
Golden Giant				
Side Oat	Burpee.	" 16	2420 "	36.2 bu
Extra Ripe	Livingston..	" 7	960 "	35.0 bu

It is seen that eight of the twenty-four varieties produced sixty or more bushels per acre. Livingston's Extra Sweedish heads the list with a yield of 67.8 bushels per acre, followed closely by Salzer's Black Prolific.

The different varieties showed considerable variation in the yield of both grain and straw. Black Prolific produced almost twice as much grain and more than twice as much straw as Extra Ripe.

RESULTS FOR 1901.

The variety test of oats which was begun last year was continued in 1901 with the addition of a few more varieties.

Before the oats were sown all of the varieties were treated for smut by the hot water method which consists in soaking the seed for ten minutes in water heated to 132 degrees Fahr. This

treatment was very effective, as there were not a half dozen smutted heads upon the plats where the seeds had been treated, while the oats in an adjoining field, in which untreated seed was used, were smutted badly.

The oats were sown during the first days of May, upon a portion of a field which had been in grass for several years. The land was plowed early in January, and when the seed was sown was in good tilth. The seed germinated well and a good stand was obtained with all of the varieties. The growth during the early part of the summer was very rapid and gave promise of a good yield, but the dry weather following checked growth and materially diminished the yield and injured the quality of the grain.

The plats were one-twentieth of an acre in size, and were fertilized at the rate of 400 lbs. of acid phosphate per acre.

The following table gives the yield of grain and straw per acre for each of the different varieties:

Variety.	Harvested.	Straw	Grain
North Finnish Black Oat...	Aug. 2	2900 lbs	57.5 bu
Big Four White.....	July 27	2740 "	56.3 bu
Silver Mine.....	" 26	2820 "	53.1 bu
White Russian.....	" 27	2420 "	53.1 bu
American Banner.....	" 25	2640 "	52.5 bu
Black Spring.....	" 23	2120 "	50.0 bu
Danish Island.....	" 25	3140 "	49.4 bu
Improved American.....	" 25	3140 "	49.4 bu
Black Tartarian.....	" 25	3180 "	48.1 bu
Great Northern.....	" 27	3800 "	47.5 bu
Black Prolific.....	" 26	2800 "	47.5 bu
Clydesdale.....	" 26	2720 "	43.1 bu
White Bonanza.....	" 26	3520 "	43.1 bu
Probster.....	" 30	2760 "	42.5 bu
Extra Sweedish.....	" 26	3540 "	42.5 bu
White Spring.....	" 26	1980 "	41.3 bu
Sixty Day, from Russia,....	" 17	2400 "	40.6 bu
Extra Ripe,.....	" 7	2300 "	40.6 bu
Golden Giant Side Oat.....	" 30	2600 "	40.6 bu
White Superior Scotch.....	" 23	2120 "	40.0 bu
Welcome.....	" 26	2900 "	37.5 bu
No. 5932, U. S. Dept. Agr..	" 26	1910 "	37.2 bu
Red Rust Proof.....	Aug. 2	2160 "	35.0 bu
Bow of Promise.....	July 25	2600 "	33.8 bu
Black Hungarian, from Naples	" 25	1710 "	21.9 bu

Among the eight varieties which produced sixty or more bushels of grain per acre in 1900, there are five which stand among the eight leading varieties in 1901. These five varieties are Silver Mine, American Banner, Big Four White, Improved American and White Russian. Extra Sweedish, which led in grain production in 1900, takes the 15th place in 1901. As it stands second in regard to the amount of straw produced, it is quite probable that it was injured more by dry weather during the fruiting period than some of the other varieties.

The leading variety in 1901 was North Finnish Black Oat, a variety not tested last year, closely followed by Big Four White and Silver Mine.

RESULTS FOR 1902.

This year the oats were sown upon a piece of land which produced a crop of rye in 1901. After the rye was harvested the land was plowed and seeded to rye and cowpeas. Both rye and cowpeas made a good growth during the latter part of the summer. The rye was plowed under March 26th, and the oats were drilled April 21st. The plats were one-tenth of an acre in size, and were uniformly fertilized at the rate of 500 pounds of complete fertilizer per acre. The seed was treated for smut by the hot water method with good results.

Owing to lack of room only twelve of the more promising varieties were tested. The table shows the yields of straw and grain per acre:

Variety.	Harvested.	Yield.	
		Straw.	Grain.
White Russian.....	July 24	2360 lbs	77.8 bu
Improved American.....	" "	2250 "	75.0 bu
Danish Island.....	" "	2400 "	75.0 bu
American Banner.....	" "	2560 "	73.1 bu
Salzer's Big Four White....	" 19	2310 "	71.5 bu
Extra Sweedish.....	" 24	2680 "	70.9 bu
Salzer's Silver Mine.....	" "	2250 "	70.3 bu
White Bonanza.....	" "	2360 "	70.0 bu
Black Prolific.....	" "	2280 "	69.3 bu
Great Northern.....	" "	2180 "	69.3 bu
North Finnish Black.....	" "	2220 "	68.1 bu
Black Spring.....	" "	1950 "	62.5 bu

The average yield, this year, of the twelve varieties, was 71 bushels of weighed oats per acre. Only four varieties produced less than 70 bushels per acre, and we may conclude that nearly all of the varieties named in the preceding table are well adapted to this section.

It is interesting to observe the influence of the amount of rainfall during the growing period upon the yield of grain. Although the varieties were grown upon a different set of plats each year, and fertilized somewhat differently, yet, as the heav-

iest application of fertilizer was applied to the poorest land, and vice versa, the available plant food at the disposal of the different varieties was practically uniform for the three years, and the differences in the average yields, for the three years, was largely caused by differences in the rainfall.

The table shows the amount of rainfall in inches for April, May, June and July for the three years under consideration, and the average yield, for each year, of the twelve varieties tested in 1902:

Year	April	May	June	July	Av. Yield bu
1900	1.51	2.14	5.39	6.93	60.4
1901	6.15	6.10	2.34	1.86	50.1
1902	3.48	1.71	7.16	8.42	71.0

In 1900 there was a slight deficiency of rainfall in April and May, but sufficient in June and July, and probably if the seed oats that year had been treated for smut the yield would have been as large as in 1902. In 1901 April and May were very wet months, while June and July were very dry, thus materially reducing the yields. On the other hand, in 1902 the conditions were reversed, April, and May in particular, being very dry, and June and July being very wet and favorable for a large yield of grain. It is thus seen that dry weather in the early part of the growing period does not affect oats so unfavorably as it does when it comes later in the season.

